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SCIENCE

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CONTENTS

The American Society of Zoologists:—

- Methods of Securing Better Cooperation between Government and Laboratory Zoologists in the Solution of Problems of National Importance:* DR. L. O. HOWARD, PROFESSOR J. G. NEEDHAM 453

The National Research Council:—

- The Organization of the National Research Council; Membership of Divisions; Research Fellowships* 458

The Industrial Fellowships of the Mellon Institute 462

Scientific Events:—

- Mineral Deposits in the United States; Summer Biological Stations; Distinguished Service Medals* 465

Scientific Notes and News 467

University and Educational News 470

Discussion and Correspondence:—

- An Immune Variety of Sugar Cane:* C. O. TOWNSEND. *The Use of Poison Gas:* HENRY LEFFMANN 470

Scientific Books:—

- Renaissance Anatomy:* ROY L. MOODIE 472

Special Articles:—

- Certain Conglomeratic Structures in Limestones in Central Pennsylvania:* HARRY N. EATON 474

Minutes of the Committee on Policy of the American Association for the Advancement of Science 474

The Utah Academy of Sciences: C. ARTHUR SMITH 475

The Kansas Academy of Science: E. A. WHITE. 476

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METHODS OF SECURING BETTER CO-OPERATION BETWEEN GOVERNMENT AND LABORATORY ZOOLOGISTS IN THE SOLUTION OF PROBLEMS OF GENERAL OR NATIONAL IMPORTANCE¹

LET us admit at once that government bureaus have great difficulty in getting men trained for their work. Let us go further, and admit that government bureaus have practically, except for certain fundamentals, to train their own men. Let us acknowledge also that the men in charge of the biological laboratories of the universities of the country are ready and anxious to train their men to be of the greatest possible service to the country, and that this readiness and this anxiety have been intensified by the great crisis through which we have been and are still passing.

How is this to be brought about? Plainly by a very perfect understanding and sympathy between the men in charge of the government bureaus and the men in charge of the university laboratories.

Although this suggestion has been made a number of times (I made it myself twenty years ago in an address before the American

¹ A symposium before the American Society of Zoologists, held at Baltimore on December 26, 1918, Professor C. E. McClung presiding, included papers and discussions as follows: Representing the Bureau of Entomology, Dr. L. O. Howard. Discussion by J. G. Needham, representing the Bureau of Fisheries, Dr. Hugh M. Smith. Discussion of Dr. H. B. Ward. Representing the Bureau of Animal Industry, Dr. B. H. Ransom. Discussion by Dr. Herbert Osborn. Representing the Bureau of Biological Survey, Dr. E. W. Nelson. Discussion by Dr. R. K. Nabours. Relation of the Council of National Defense and the National Research Council to the Advancement of Research, Dr. John C. Merriam.

Society of Naturalists at Baltimore), this present discussion is, I hope, an emphatic and practical beginning of a definite movement which will bring results. It is primarily, perhaps, for the government men to point out the needs. They are now assured of the warm desire to cooperate on the part of the university men, and it is only by the closest cooperation that the best results can be secured. This involves more than mere suggestions from the government to the universities. It should mean a thorough knowledge on the part of the heads of the university laboratories of the intimate nature of the problems being studied and of the methods which are being adopted to solve these problems. Such a knowledge as this can best be gained by personal contact with the workers, and such contact should be of such a nature as to bring about not only suggestions to the teachers as to the best methods of training their men for future government work but also suggestions from the trained minds of the teachers as to other directions or means of attacking the problems which the government is trying to solve.

It would be an ideal arrangement if every highly trained laboratory man in the principal universities could be made a collaborator of some government scientific bureau and could be permitted and encouraged at government expense to visit for a longer or shorter time the different field laboratories of the government working in lines in which he himself is working, and thus bring about the personal knowledge and personal contact necessary for both lines of suggestion. Such an arrangement in a large way is probably impractical at present, but it might be started in a small way and in individual cases and will probably become eventually a fixed and valuable policy.

And now as to teaching and the training of workers, I don't know whether as a rule teachers have kept positive and relative values clearly in their own minds and in the minds of their students. Do they point out plainly the practical utilizations of zoology? Do they show their students the whole of the field

that is open to the trained investigator, and do they make their teaching as broadly attractive as possible? Have they made enough use of the great out-of-doors? Are they utilizing to the full the educational help of the motion picture?

In general, a man coming from a university to that branch of the government service with which I am connected should be fundamentally sound in botany, chemistry and physiology, and he should have an acquaintance with the principal foreign languages in which the results of important work are published.

There is need, as my colleagues who are to speak for other government bureaus will readily admit, for several different types of men in the service—men who have been trained for different kinds of work—and this should be borne in mind in considering the following suggestions.

We need more training in taxonomy, that basic branch of zoology upon which all other work rests.

We need an infinite amount of investigation in the different tropisms, in behavior, in all ecological lines, and, considering relative values, forms should be chosen for such studies from among those species which have an important economic rank or from among very closely related forms. In many cases enormous time has been comparatively wasted from the want of recognition of the importance of this point.

There should be careful training in the planning of experiments, in the interpretation of results, in the collation of suggestive results, and in the preparation of reports. The average man coming from a university is woefully lacking in the latter training, and gains it with slow progress after entering the government service.

As to cooperative work between the universities and the government laboratories, in addition to the training of men by the former for service in the latter, there is much that can be done aside from this training and the possible official collaboration of certain teachers with traveling privileges hinted at in a former paragraph.

Constant suggestions might be made from the government laboratories to teachers concerning the lines of work that might be taken up by advanced students in preparation for theses which would fit in with general investigations being carried on by the government. It is extraordinary that such suggestions have not been asked for by teachers, or that they have not been made in considerable number by government men engaged in zoological work. I am informed by Dr. Alsberg that such a policy exists in regard to chemical problems and that the Bureau of Chemistry often assigns practical research problems to university men who have the laboratory facilities and the time to devote to research.

This naturally suggests the research fellowships which are beginning to be founded in certain universities by certain industrial organizations, and with this in mind the thought arises: Might not the government itself found fellowships at universities for the investigation of certain problems in applied science?

The laboratories of the larger universities are fitted out with costly and extensive apparatus which while existing doubtless in some of the government laboratories, are not duplicated in any number in field laboratories. Such apparatus as hydrographic machines, respirometers, calorimeters and others belonging to the university should, by collaboration, be used in practical government investigations. An admirable example of this kind of cooperation is the elaborate work on the wintering of bees which was done a few years ago at the University of Pennsylvania in collaboration with the Bureau of Entomology.

There is much that might be considered in this general way, and there are many specific things that occur to me, but which it will be undesirable to take the time to advance at present. Expecting that the approximate soundness of what has been said will be admitted, it seems to me that a practical step towards putting the whole matter on a cooperative basis will be to organize a permanent committee of government men in Washington, to whom definite suggestions can be sent by university and government workers and who

can discuss these suggestions, arrange them in practical form, and distribute them where they can do the most good. Such a committee would therefore be a clearing house for ideas, and its opinion as to the value of the ideas and the best and most practical way of carrying them out would carry weight. Perhaps there should be associated with this committee and as members of it certain strong men from nearby university zoological laboratories.

I welcome most heartily the movement which has brought about this symposium and which bids fair to have results of much importance.

L. O. HOWARD

THE problems of national importance with which we are called upon to deal are doubtless those having to do with the biological needs of our species. These fall into three principal categories: Needs of food, needs of shelter, needs of defense.

These are the primary needs of all animals. Given proper physical conditions—suitable air, moisture, temperature, pressure, etc.—these are the matters in respect to which every species must make its own provision. Of these, food is the most insistent and ever-recurrent need. Shelter is for our species a little different from that of other species, since it means for us clothing and housing of a very artificial sort. Defense also has grown different, though the categories of our natural enemies are the same. They are: (1) Enemies to be escaped, because of their superior powers; (2) enemies to be fought, there being a fighting chance to overcome them; (3) enemies to be dispersed, because individually insignificant; (4) enemies to be endured (at least until we have means for their control) because they are so small.

Invention has enabled us to cope with all our enemies save a few of the smallest of them. We have improved our fighting weapons until all the great beasts have been put

completely within our power, and our worst remaining enemies are those of our own species. The only needs of defense that Mother Nature imposed upon our species were needs of power to combat enemies of other species and to meet the rigors of our environment; all else is but a self-imposed burden.

I judge by the topics of this conference that it is the need of food that we are mainly called upon to consider. The conservation of food, through the control of insect destroyers of it, is a prime duty of Dr. Howard's bureau and of several others. So of food I shall speak. Years ago when writing a text-book of general biology, desiring to have said something when I got to the end of the first sentence, I wrote: "The primary demand of individual livelihood is for food;" and after a dozen or more years of subsequent reflection upon the subject, I think that that is about the most important biological statement I ever made.

Our species began by eating what Mother Nature provides ready made, as the animals eat. Such plant products as fruits, nuts, roots; such animal products as eggs and oysters, were at once available for consumption. But unlike the other species, we have vastly increased the range of our diet, first by the use of fire in cooking, and then by the care and cultivation of the more valuable food-producing species in agriculture. Thus the entire range of the world's organic food stuffs is becoming available for the use of our species, in a small part unmodified as in the beginning, in a larger part after milling and culinary treatment, and in by far the largest part, after several turnovers by biological agents. In this last direction we have made only a beginning. I regard it as the field most promising in results for future research.

Our food is fundamentally the same as that of animals, and many animals are competitors with us for the same supplies. Some of these animals, like rats and mice and cockroaches, having dietaries like our own and appreciating our shelter as well as our food stores, have gone all over the world with us and have become our permanent associates. Many others

have settled in our fields where, by raising their food plants in mostly pure cultures, we have greatly improved the means of sustenance for them.

The pioneer when his fields became infested with pests could escape their competition for a time by opening new fields in another locality; but that was when land was plenty and men were few. Now, the land is filled. The people are here and must be fed. This is going to require that all the fields yield their full measure of increase every year, and that all that is raised be saved for human use. This then is one great national problem; to raise more food and to save what we raise from the ravage of competing species.

In the task of finding out the best means of accomplishing these needs, government and university biologists are collaborators. Their highest function, that of research, they have in common. They have, also, functions apart, that of the university being to train men for this work, and that of the government bureaus, to administer the work throughout the land. We are met here to consider the problem together, and to ask whether there are ways of making better progress through co-operation and mutual aid.

Dr. Howard's suggestions appear to be along two lines: Better training of men for the work; better facilities for exchange of experiences.

If the first seems to reflect on the training done in the universities, nevertheless it is a good suggestion and one that is always in order, and when it comes from so good a friend and so competent a critic of our work, accompanied by specific suggestions for improvement, it is more than welcome and we shall try to meet it. When he suggests in substance that we put the most important thing foremost, I am not sure that we will be able to agree with him or even with one another as to what is most important. It is important to give the student a good foundation in the fundamental sciences, for only on this may a superstructure of technical knowledge safely be reared. It is also necessary in this day of specialization to give as much

training as possible for particular lines of work. To the teachers of the fundamental sciences, the whole time of a college course seems inadequate for the first. To the specialist all the time seems required for the second. Both aims are proper aims but they are forever at variance. The course of study is always a compromise between the two; and the difficulties of making the compromise satisfactory grow with ever increasing knowledge. Yet human life is not appreciably lengthened, and the years that a youth may wholly devote to preparation for service are not increased. Probably some time may be gained for special training by more rigorous selection of materials for fundamental courses, by the limitation of the work of these to essentials, and by avoidance of duplication. This can be done and should be done.

Dr. Howard suggests that we give more time to taxonomy and ecology and less to physiology and genetics. This is a good suggestion. We are all out of balance. Some of our laboratories resemble up-to-date shops for quantity production of fabricated genetic hypotheses. Some of our publications make a prodigious effort to translate everything biological into terms of physiology and mechanism—an effort as labored as it is unnecessary and unprofitable. Why not let the facts speak for themselves? Our laboratories are full of fashions. They go from one extreme to another. In my high school days we learned systems of classification; in my college days we did nothing but dissecting; later came morphology and embryology, then experimental zoology, then genetics, and the devotees of each new subject have looked back upon the old with something like that disdain with which a debutante regards a last year's gown. Natural history and classification are perhaps long enough out of date, so that interest in them may again be revived. I hope so; for these are the phases of biology by means of which a youth is best oriented for more special work. Then, too, they are immensely practical. One has to deal with species, and must be able to recognize them; and all economic procedure is applied ecology.

As to the training of men for report making that Dr. Howard suggests, I am a bit more doubtful. There are reports and reports. For the making out of reports merely to comply with governmental red-tape, I do not care to train men. Experience is the only school for this. And as to the training needed for making reports of the results of investigation, it is often training in restraint that is most needed. I hope it is not training in the construction of imposing and impressive diagrams that Dr. Howard has in mind. I have seen some such at these meetings, built like a sky-scraper, and far harder to understand than the few simple facts they were intended to set forth and explain! I set but three requirements before students in my own laboratory: (1) Clear analysis of the subject matter, (2) simple drawings, (3) good English—and not too much of it.

After all, if Dr. Howard has to take men from the universities and train them on his job, I do not feel badly about it, nor wholly responsible. Indeed, if we in the universities do our best, as assuredly we will, I think this will always be so; and if it were not so I should know that Dr. Howard's work was dead, and making no further progress; for, faster than we can equip and organize our teaching to meet new needs, new methods will evolve and demands for help will spring up in unexpected places.

Now as to cooperation, Dr. Howard suggests that the government provide means whereby properly trained men from the university laboratories may visit the government field laboratories for the purpose of acquainting themselves with the work there going on. Nothing better could be devised to give that purpose and direction to our teaching that he desires. Nothing could do more to infuse new vigor into our work of research. It would result first of all in substituting for some of the puny problems of our laboratories of sickly forcing-house types, others of the robust field-grown type, to which a young man might give his time and labor without reserve, and without a question as to its usefulness and value. It would check the tendency

to congregate in a few popular marine laboratories, there to run and howl with the pack, and would lead to greater independence in our scientific spirit and work.

Over against this suggestion of something the government might well do, I would place a suggestion of something the universities might well do. In the interests of their own work and of keeping it abreast of the times, they might make provision for sending their investigators each year to meetings such as this one, and to all national meetings in the field of the sciences that they cultivate: I mean, pay their traveling expenses. It would cost comparatively little and would help to keep both men and institutions alive.

Such means of getting together would provide opportunities for the exchange of experience, for learning new methods and for getting help from fellow specialists.

After all, we need to realize that cooperation in research has its serious limitations. Real research is nearly always the work of individuals. Nature does not yield up her secrets to a crowd or even to a committee, but only to her humble devotee, when working alone and apart. When a man is found working at a problem for which he is well trained and well equipped and in which he has both faith and zeal, the best way to cooperate with that man is to let him alone and keep out of his road.

Cooperation is limited in advance to getting oriented, and getting equipped. But after a discovery of a fundamental nature has been made, then cooperation is needed to learn the limits of its application. Life is a complex of changing factors, and environment is a complex of instable conditions. A good method is often good only locally and under certain conditions. Especially in field work in entomology it needs to be tested out zone by zone and province by province; and the cooperation of many hands in many places is needed to find its limitations, and its true economic value.

Let us meet and exchange experiences. Progress in knowledge usually depends on our ability to take a hint from nature, as to where

to look and what to look for: and the hint we may often obtain from the work of another. Betterment of methods oftenest grows out of comparison of results. Let me assure Dr. Howard that laboratory men are not unmindful of the limitations of laboratory methods, nor unwilling to go out in the field and acquaint themselves with the scientific problems the work of the bureau has raised, nor indisposed to do all they can to help solve them.

J. G. NEEDHAM

CORNELL UNIVERSITY

THE NATIONAL RESEARCH COUNCIL ORGANIZATION OF THE NATIONAL RESEARCH COUNCIL¹

PREAMBLE

THE National Academy of Sciences, under the authority conferred upon it by its charter enacted by Congress, and approved by President Lincoln on March 3, 1863, and pursuant to the request expressed in an Executive Order made by President Wilson on May 11, 1918, hereto appended, adopts the following permanent organization for the National Research Council, to replace the temporary organization under which it has operated heretofore.

ARTICLE I.—PURPOSE

It shall be the purpose of the National Research Council to promote research in the mathematical, physical and biological sciences, and in the application of these sciences to engineering, agriculture, medicine and other useful arts, with the object of increasing knowledge, of strengthening the national defense, and of contributing in other ways to the public welfare, as expressed in the executive order of May 11, 1918.

ARTICLE II.—MEMBERSHIP

Section 1. The membership of the National Research Council shall be chosen with the view of rendering the Council an effective federation of the principal research agencies

¹ Approved by the National Academy of Sciences at its meeting on April 30, 1919.